THEORY OF ORGANIZATIONS AND PROJECT ANALYSIS OF MANAGING CHANGES IN PROFESSIONAL COMPETENCIES IN ACADEMIC ENTREPRENEURSHIP IN THE CONTEXT OF HUMAN RESOURCE MIGRATION, TOURISM BUSINESS AND INTERNATIONAL MARKETING

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Abstract

The study identifies the crucial issue of managing transformations of professional competencies in sectors such as academic entrepreneurship, tourism business and international marketing, especially during the growth of human resource migration. The research in the scientific article deepens the synthesis of traditional methodological approaches to planning and project management tools, which allows for a deep reflection of the trends in the transformation of expertise in modern business entities. Scientists have proposed a system of adaptive mathematical and economic models that take into account systemic factors such as turbulence, nonlinearity, asymmetry and resource efficiency limitations. In practice, these models allow for quantitative modeling of trends in competency adaptation, calculating the degree of sufficiency during skills improvement, investigating the impact of turbulence in the tourism business, and also clarifying the balance between productivity and the negative consequences of migration. In particular, the proposed mathematical models will allow for determining the level of dynamic sustainability of academic entrepreneurship. The conclusions of the scientific article prove that competence management is a systemic, extremely complex multidimensional process. Its core is the systematic updating of science and technology, the accumulation of highly qualified personnel, risk hedging and the effective combination of innovation and human capital development. The practical value of the conclusions of the scientific article is based on the possibility of implementing the proposed models for adaptive strategizing the activities of educational and business structures. Mathematical models should be used in planning strategies aimed at preserving human capital in the conditions of a global economy and total migration of human resources.

Introduction

In the current era of global change, enterprises are faced with a total need to transform their management skills, which is due to the synergy of three key sectors: human resource migration processes, structural changes in the tourism business and increased competition in the field of international marketing. Such transformations require an update of the concept of personnel management, since traditional approaches to competency-based training and personnel retention are losing their relevance, where there is high personnel migration, cultural and ethnic diversity and digitalization of the system of economic relations.

Organizational theory, which scientifically summarizes the laws of implementation and development of the institutional matrix, today needs improvement in the direction of synergy with the tools of project analysis. Thus, project analysis provides a methodological basis for designing changes, which allows us to calculate not only the financial effectiveness of changes, but also their impact on the development and functioning of specialists' competencies. Under such conditions, such parameters as the ability of personnel to adapt to changing conditions, the inertia of knowledge accumulation, the possibility of cross-communication and the variability of organizational conditions are actualized.

It is important that academic entrepreneurship, which is a chain between education, science and entrepreneurship as a whole, faces powerful obstacles: on the one hand, the generation of new knowledge and innovations, and on the other, synergizing them into production practice, which are constantly transformed under the influence of global and regional factors. Business in the field of tourism is a particularly sensitive industry, because it is directly dependent on the mobility of human resources, the geopolitical situation and the index of trust of the population or the consumer of the final product. International marketing, in turn, stimulates the formation of powerful communication channels and sales, which do not exist without highly specialized specialists with developed interdisciplinary skills and a high level of cultural communication.

In the context of personnel migration, the issue of professional competence management becomes particularly relevant, because it is human resources that determine the strategic advantages of enterprises. Migration of specialists is the cause of financial losses and the accumulation of degradation of personnel or professional staff. In this context, mathematical modeling of control of changes in competencies is especially relevant for business institutions, business structures in the tourism or marketing spheres.

The scientific novelty of our scientific article is based on the synergy of key concepts of the theory of organizations with project management of changes in competencies in a turbulent environment and total uncertainty. The implementation of complex statistical and mathematical models in practice formalizes processes that were classically considered in science only by qualitative indicators. In our study, five mathematical models were simulated, the use of which allows us to quantitatively assess and plan changes in competencies in academic entrepreneurship, tourism business and international marketing, in conditions of turbulent changes and increasing migration processes.

Literature review

The analysis of scientific literature indicates the importance of analyzing this issue and confirms its importance for the adaptation and effective development of modern business entities in various segments of the national economy.

Prokopenko et al. (2021) model the clustering of public administration, marketing and the labor market to increase the sustainability of economies; Baum & Szivas (2008) substantiate the role of the government in tourism HRD as a factor of competitiveness; Alka et al. (2025) map the research on migrant entrepreneurship using BERTopic, identifying thematic clusters; Gryshchenko et al. (2023) propose the design of an institutional environment for innovative entrepreneurship in post-war reconstruction; Bakhmat et al. (2022) analyze the quality management of higher education through the lens

of sustainable development; Baum (2018) proves that sustainable HRM is an underestimated driver of tourism policy and planning; Bosniuk et al. (2021) highlight the social content of psychologists' professional activities, emphasizing competency and ethical dimensions; Cakmak, Lie & McCabe (2018) explain informal entrepreneurship in tourism through capital and the field of social relations; Hnatenko et al. (2024) conduct a market analysis of Ukraine's renewable energy taking into account financial and economic shifts; Carlisle et al. (2013) demonstrate that multi-stakeholder approaches enhance tourism innovation and decision legitimacy; Chen & Barcus (2024) describe women's "returned" entrepreneurship in rural China through empowerment, cooperation, and networks; Mazur et al. (2021) propose improving controlling in the financial management of enterprises; Ganguli & Ebrahim (2017) analyze the competitiveness of Singapore's medical tourism as an institutional and brand phenomenon; Prylipko et al. (2021) model regional management of innovation activity through personnel, financial and credit, and foreign economic activity components; Janta et al. (2011) show the impact of migrant networks on employment in tourism; Kubitskyi et al. (2023) outline the challenges of HEI development: management, digitalization, internationalization; Mykhailichenko et al. (2021) explore competitive HR strategies in agribusiness focused on digitalization; Ladkin (2011) systematizes the nature of labor in tourism and its flexible forms; Liu & Wall (2005) consider HRD in Chinese tourism, emphasizing the role of public policy and education; Hnatenko et al. (2020) analyze the infrastructure of an innovative enterprise and regulatory mechanisms; Purdenko et al. (2023) offer financial solutions for innovative eco-entrepreneurship; Riddle, Hrivnak & Nielsen (2010) show how diasporic entrepreneurship overcomes institutional gaps in emerging markets; Semenov et al. (2021) develop approaches to managing energy and resource-saving innovation projects in the agro-industrial complex; Shumilova et al. (2023) describe a system for forming emotional and ethical competence of future education managers; Volery et al. (2013) record the positive impact of entrepreneurship education on students' human capital; Voznyuk et al. (2022) model synergistic management of educational processes through temporary self-managed target teams; Zhyvko et al. (2024) analyze the impact of the US stock market on the institutional security of innovation development management.

The analysis of scientific literature emphasizes the relevance of a comprehensive approach to the effectiveness of professional competence management, taking into account financial, institutional, behavioral and technical changes. The generalization of theoretical achievements has actualized the development of complex mathematical-statistical models for managing changes in professional competencies.

Research methodologies

The study of change management of professional competencies is based on a combination of old and new ideas about the organization with project analysis methods. Traditionally, organizations were viewed as open systems that constantly interact with the outside world. Any changes within them were considered a response to external challenges or internal adaptation needs.

However, in the context of rapid migration processes, digital globalization and constant changes in international markets, this classic view becomes insufficient. It does not take into account how quickly knowledge and skills become obsolete, and how quickly the competencies themselves change. The project analysis methodology helps to solve these problems. It considers changes in the organization as a series of sequential steps, each of which has clear goals, necessary resources and defined deadlines. The main attention is paid not so much to the organization itself, but to specific change processes. This means that it is necessary to assess the effectiveness, risks and possible ways of developing these changes. For competency management, this means the ability to plan personnel development as a project. It is important not only to train people or improve their qualifications, but also to help them apply the acquired knowledge in new conditions.

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Competence management is a complex task, since competences have different dimensions. On the one hand, these are specific skills and knowledge (for example, computer skills or knowledge of foreign languages). On the other hand, it is a socio-cultural aspect: the ability to communicate with different people, adapt to new cultures and be part of global processes.

Due to this duality, assessing competences only with qualitative methods (surveys, observations) is not enough. Quantitative tools are needed that can take into account complex relationships and the nonlinear impact of various factors. The migration of qualified employees is another important aspect. The loss of such personnel not only leads to financial losses, but also reduces the company's ability to innovate. Project analysis allows us to consider these losses as risks that can be taken into account in mathematical forecasting models. Thus, the novelty of this approach lies in the combination of traditional organizational analysis with quantitative methods of risk assessment and resource optimization.

Three main principles for choosing research tools:

Systematicity: The organization is considered as a single whole, where a change in one competency affects all others.

Dynamics: Time factors such as slow development, skill obsolescence and learning speed are taken into account.

Optimization: The best ways of managing competencies are sought, taking into account limited resources and the uncertainty of the external environment.

From a scientific point of view, this means the need to develop complex mathematical models that combine general indicators, complex change functions and probabilistic dependencies.

Results

Effective management of the evolution of competencies in complex socio-economic systems is aimed at implementing multi-level mathematical models. These models allow to adequately represent the nonlinearity, inertia, stochasticity and interdependence of factors that form the competency potential of organizations. Multi-integral index of competency dynamics (MICD):

$$MICD_t = (\frac{1}{T}\int_0^T \sum_{j=1}^n (x_j(\tau)w^j \cdot e^{-\lambda j(T-\tau)}))d\tau^\theta$$

where:

$x_j(\tau)$ – value of the jth competency indicator at the moment of time (τ);

w^j – weighting factors of importance of competencies, $w^j = 1$;

λj – degradation coefficient (rate of skill aging);

T – observation period;

θ – elasticity parameter modeling the synergy of competencies.

$MICD_t$ takes into account: dynamics of competencies over time; obsolescence of skills through the exponent; synergistic effect ($\theta > 1$) enhances the result, ($\lambda 1 < 1$) smooths it).

Calculation (hypothetical university):

digital literacy ($x_1=0.8$, $w_1=0.4$, $\lambda_1=0.02$);

innovativeness $x_2=0.7$, $w_2=0.35$, $\lambda_1=0.03$);

communication $x_3=0.6$, $w_3=0.25$, $\lambda_13=0.01$);

$T=10$, $\theta=1.1$).

Numerical integration gives MICD ≈ 0.72), which indicates 72% competency change.

In this case, the competency change model looks like (NTC):

$$NTC = \alpha \tanh(m / k = 1)\beta k_y (\rho/k) + \gamma(1/1 + e(-\delta)(R0 - R))$$

where:

y_k – competency factors (level of education, training, career growth);

ρ – level of vague influence;

R – current level of personnel risks;

$R0$ – parametric level of excessive risk;

$\alpha, \beta k, \gamma, \delta$ – parameters.

The model shows that competence development has a saturation effect (via tanh), and migration risks can sharply reduce efficiency when a critical threshold is exceeded ($R0$).

Calculation (hypothetical marketing agency):

$y1 = 5, y2 = 7, \beta1 = 0.3, \beta2 = 0.2, \rho = 2;$

$\alpha = 2, \gamma = 1.5, \delta = 0.05, R = 25, R0 = 20;$

$$NTC = 2 \cdot tanh(0.3 \cdot 25 + 0.2 \cdot 49) + 1.5$$
$$\cdot \frac{1}{1 + e^{-0.05(-5)}}$$
$$NTC = 2 \cdot tanh(7.3 + 9.8) + 1.5 \cdot \frac{1}{1 + e^{-0.05(-5)}}$$
$$NTC = 2 \cdot tanh(17.1) + 1.5 \cdot 0.44$$
$$\approx 2 \cdot 0.9999 + 0.66 \approx 2.66$$

Therefore, the transformation efficiency is equal to 2.66 points.

Stochastic model of the efficiency of tourism activities (SMTD):

$$SMTD = \frac{E[\sum_{i=1}^{p} \theta i Q i]}{\sqrt{\sigma_{ext}^2 + \sigma_{ext}^2 + 2\rho\sigma_{ext}\sigma_{int}}}$$

where:

Qi – income from the tourism product of the i-th segment;

θi – market share;

$\sigma_{ext}\sigma_{int}$ – standard deviations of external and internal risks;

ρ – correlation coefficient between risks.

The formula takes into account not only average returns, but also the interdependence of risks. If the risks are positively correlated ($\rho{>}0$), the total uncertainty increases, if negatively ($\rho{<}0$) - partial mutual compensation occurs.

Calculation (hypothetical tour operator):

income: Q_1=80, Q_2=60, Q_3=40;

particles: θ_1 =0.5, θ_2=0.3, θ_3=0.2;

risks: σ_{ext}=5, σ_{int}=4, ρ =0.5.

$$SMTD = \frac{0.5 \cdot 80 + 0.3 \cdot 60 + 0.2 \cdot 40}{\sqrt{25 + 16 + 2 \cdot 0.5 \cdot 20}} \approx 8.45$$

So the efficiency is $\approx$ 8.45 conventional units.

Optimization Model for Human Capital Conservation (OMHC):

$$maxZ = \sum_{i=1}^{n}(PiCi - LiMi) - \eta \cdot \sum_{i=1}^{n} \frac{M_i^2}{K_i}$$

under the conditions:

$$\sum_{i=1}^{n} Mi \leq Mmax, Mi \geq 0$$

where:

Pi – productivity of the personnel of the i-th division (120; 100);

Ci – coefficient of retention of competencies (0.8; 0.9);

Li – losses from migration of one employee (40; 50);

Mi – number of employees prone to migration (10; 15);

Ki – personnel capacity of the division (50; 60);

η – penalty coefficient for imbalance (0; 5).

The calculation shows on the example of a startup:

Z = -966.9, that is Z<0, indicating that the losses outweigh the benefits, the organization loses personnel sustainability.

Dynamic Function of Academic Sustainability (DFSAE):

$$DFSAEt = \lambda Dt + \mu \cdot \frac{Rt}{1 + e^{-\kappa(Et-E0)}} + \xi \cdot sin(\omega t + \varphi)$$

where:

D_t – level of innovation activity;

R_t – income from projects;

E_t – average level of competencies;

E_0 – critical level of competencies;

λ, μ, k − influence parameters;

$\xi \cdot sin(\omega t + \varphi)$ – seasonal component, which takes into account cyclical fluctuations in demand.

The formula combines the linear contribution of innovations, the nonlinear effect of competencies and the periodicity of seasonal fluctuations.

Calculation (hypothetical innovation cluster):

$\lambda = 0.5$, Dt =150, $\mu = 0.7$, $Rt = 800$, $Et = 75$, $E0$=60, $k = 0.1$;

$\xi = 50$, $\omega = 0.5$, $\varphi = 0$, $t = 10$.

$$DFSAEt = 0.5 \cdot 150 + 0.7 \cdot \frac{800}{1 + e^{-0.1 \cdot 15}} + 50 \cdot sin(5)$$
$$= 75 + 0.7 \cdot \frac{800}{1 + e^{-0.1 \cdot 15}} + 50 \cdot (-0.96)$$
$$= 75 + 0.7 \cdot \frac{800}{1 + 0.22} - 48$$
$$\approx 75 + 0.7 \cdot 655 - 48$$
$$\approx 75 + 458.5 - 48 \approx 485.5$$
$$= 75 + 0.7 \cdot 1 + 0.22800 - 48$$
$$\approx 75 + 0.7 \cdot 655 - 48$$
$$\approx 75 + 458.5 - 48 \approx 485.5$$

Therefore, the calculated dynamic stability index $\approx$ 485.5 indicates a high ability to accumulate innovative potential despite seasonal fluctuations.

Conclusions

The article proposes a system of mathematical models that enable interested stakeholders to analyze individual sectors of

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competence transformation management in a complex and turbulent environment. The use of such models has shown that the results of management decisions vary greatly depending on risk hedging, the degree of skill degradation, and the ability of organizations to integrate innovative resources. We have determined that the index and its adaptability with sufficiently high indicators of individual competence sectors may be lower than planned due to the effect of reducing knowledge diffusion. This demonstrates that business entities and educational centers should strive to build competencies, systematically update them in order to avoid transactional and transformational losses. At the same time, the nonlinearity of the efficiency function determines the emergence of a hypothesis about the accumulation phenomenon: total finance in the development of human capital does not give the desired result after passing a certain threshold. At the same time, the presence of migration has shown itself to be a critical factor: an increase in the level of risks greatly minimizes efficiency. The above indicates that the policy of professional competence development should be synergistically combined with the planning of sustainable professional development.

At the same time, the stochastic model of tourism activity showed that the result of the work of business entities depends not only on profits, but also on the dependence between external and internal risks. At the same time, with effective interaction, riskiness and turbulence increase significantly, reducing the overall result. The above indicates that the requirement for diversification of tourism products, as well as the implementation of a strategy, minimizes the impact of total shocks.

However, the model of optimization of human resource support showed that for business entities whose activities have problems with personnel policy, financial losses from migration significantly reduce positive productivity results and create a negative financial result.

Thus, the obtained modeling results indicate that the developed functions can be used for planned strategic management of changes in competencies in conditions of turbulence and uncertainty. Based on their results, it is possible to assess the current state and plan the consequences of management decisions under various development scenarios.

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